Large-scale, high-resolution wind resource mapping for wind farm planning and development in South Africa

Mortensen, Niels Gylling; Badger, Jake; Hansen, Jens Carsten; Mabille, Eugéne ; Spamer, Yvette

Publication date:
2014

PO.ID 102

Large-scale, high-resolution wind resource mapping applied for wind farm planning and development in South Africa

Niels G. Mortensen, Jake Badger and Jens Carsten Hansen / Eugéne Mabille and Yvette Spamer
Technical University of Denmark (DTU) / Council for Scientific and Industrial Research (CSIR)

Abstract

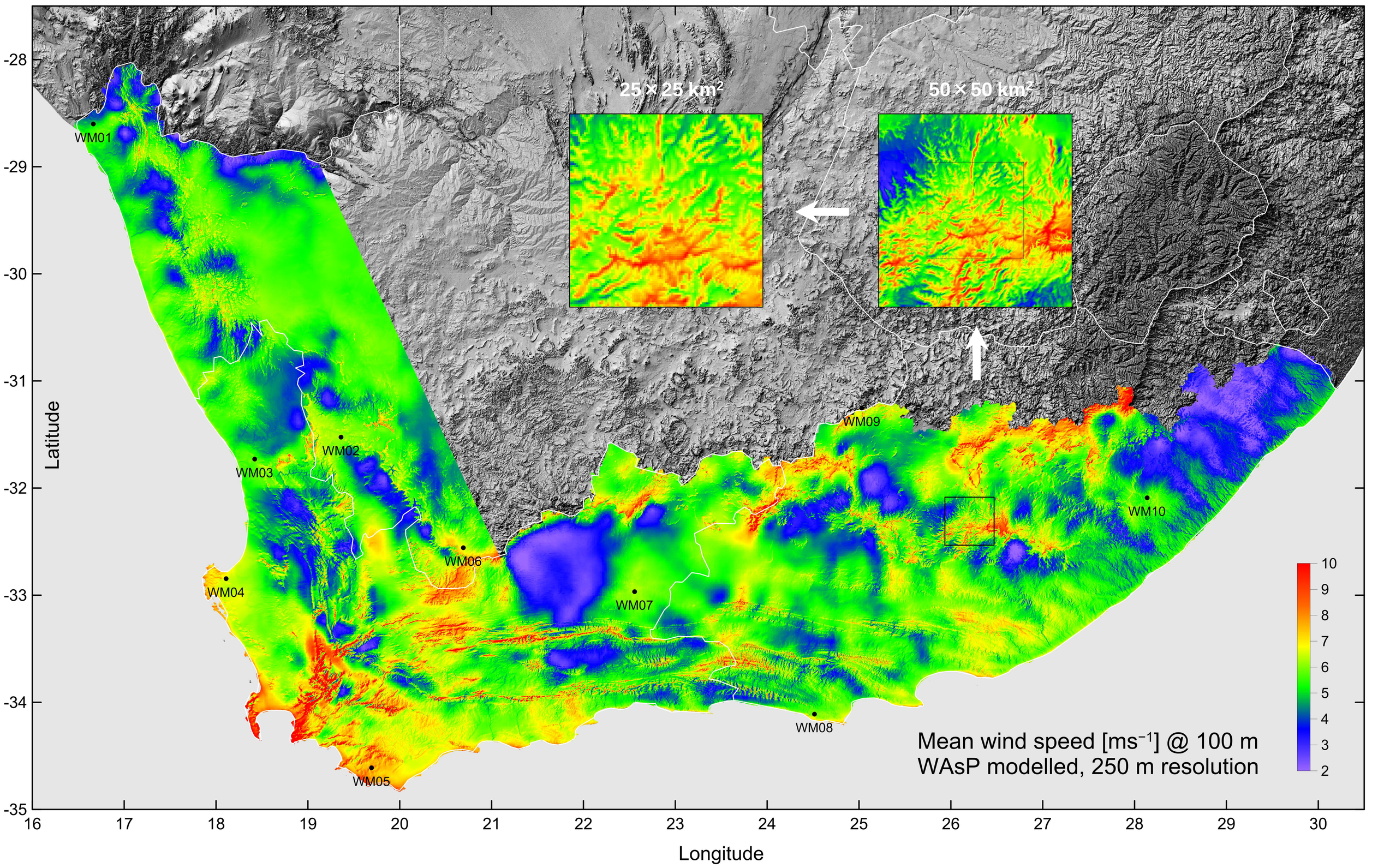
Numerical wind atlas data at 5 km resolution have been used to map the wind resources of the *Wind Atlas for South Africa* domain in great detail: mean wind speed, mean power density, elevation and ruggedness index for every 250 metres over 350,000 square kilometres. The detailed wind resource estimates have been made available in GIS formats and are designed for national and provincial planning and strategic environmental impact assessment for wind power in South Africa. An updated version of the wind resource database will be available in the spring of 2014.

Method

Verified numerical wind atlas data based on statistical-dynamical downscaling (KAMM/WAsP method) have been used to map the wind resources of the *Wind Atlas for South Africa* domain (350,000 square km) in great detail (250 m) using WAsP Resource Mapping – an automated implementation of WAsP. The topographical data used for this high-resolution modelling are 20-m digital elevation contours from 1:50,000 South African topographical maps and land cover information from the USGS Global Land Cover Characteristics database (GLCC). WAsP engine was run with default parameters.

Results

The outputs of the WAsP modelling are 250-m grids of long-term mean wind speed and mean power density, terrain surface elevation and terrain complexity (RIX). The map shows the mean wind speed at 100 m a.g.l., with insert maps covering 50 × 50 and 25 × 25 km^2. The results have been verified at 10 met. mast sites (WM01-10) and overall seem to be approximately 10% too low. Half of the bias is caused by the KAMM numerical wind atlas, the other half by the WAsP roughness maps. Updated versions of input data and results are in the making and will be published in the spring of 2014.



Application

This new data base of high-resolution wind resource estimates can be used for strategic environmental assessment and wind farm planning and development. The data base has already been employed by the Department of Environmental Affairs and Development Planning, Provincial Government of the Western Cape, and by the Department of Environmental Affairs, for GIS-based strategic environmental assessments (SEA) for the Western Cape Province and for the entire WASA domain, respectively. This work was presented recently by Cornelius van der Westhuizen: Methodology and initial results of the DEA wind Strategic Environmental Assessment. *Windaba 2013 Conference and Exhibition*, Cape Town, see www.csir.co.za/nationalwindsolarsea.

References

SANEDI's Wind Atlas for South Africa (WASA) site, www.wasaproject.info, contains general information about the Wind Atlas for South Africa project.

WASA data are displayed online at the CSIR Online site, www.wasa.csir.co.za. Weather Research and Forecasting model (WRF) wind forecasts are available from veaonline.risoe.dk/wasa.

The main WASA download site contains all the 10-min data collected at the 10 meteorological masts. The site wasadata.csir.co.za/wasa1/WASAData also contains a 'Wind Atlas download section' where a Numerical Wind Atlas, Observational Wind Atlas, several reports, tools and guidelines are available for download.

Acknowledgements

The Wind Atlas for South Africa (WASA) project is an initiative of the South African Government, Department of Energy (DoE) and the project is co-funded by

- UNDP-GEF through South African Wind Energy Programme (SAWEP)
- Royal Danish Embassy

South African National Energy Development Institute (SANEDI) is the Executing Agency, coordinating and contracting contributions from implementing partners: Council for Scientific and Industrial Research (CSIR), University of Cape Town (UCT), South African Weather Service (SAWS), and DTU Wind Energy (formerly Risø DTU National Laboratory for Sustainable Energy).